Space Weather Technical Forecast

Issued on Sunday 3 November 2024 at 00:17 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate to High solar activity with M-flares expected, and a slight chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity was moderate with two M-flares, the largest of which was a M1.2 at 02/0831 UTC from AR3876 in the southwest. There are thirteen active sunspot regions on the visible disc, with three as yet un-numbered new regions. AR3878 in the NE, and the cluster of spots in the SW, remain the most active flare source regions. AR3878 still has two delta spots visible within its larger trailer portion, although one of these appears to be weakening slightly. AR3869 remains the most complex region within the cluster of spots in the southwest. AR3881 in the SE continues to develop with quite large leading and trailing spots. Other sunspots only showing slow evolution currently.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured at L1 by ACE/DSCOVR were mostly at slightly elevated levels, reaching a brief peak of 508km/s, but have since fallen to around 450km/s. Density was below average throughout. The Interplanetary Magnetic Field (IMF), Bt, was mostly moderate 8-12nT. The north-south component, Bz, was mostly weak, though did see extremes of -12nT and +11nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp1-4).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was elevated but remained below S1 Minor Radiation Storm level throughout. High energy electron flux (greater than 2MeV) observed by GOES16 was Background to Moderate. The associated 24-hour fluence was well below the Active threshold, with 2.72e6 integrated flux observed at 03/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate or High activity is expected to continue into the start of the period, with occasional M-class flares expected and a slight chance of isolated X-class flares. Into days 2-3 (04-05 Nov) flare risk perhaps reducing somewhat as active regions in the west begin to rotate off the visible disk.

Solar Wind / Geomagnetic Activity: A CME which left the sun during the 31st Nov has the potential to give a glancing blow to Earth late on day 1 (03 Nov) or into early day 2 (04 Nov). Quiet

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to Unsettled geomagnetic activity is expected initially, with a chance of isolated Active intervals due to transient enhancements. Activity expected to increase to become more generally Unsettled later on day 1 (03 Nov) and day 2 (04 Nov), with a chance of Active and a slight chance of G1/Geomagnetic Storm intervals given the risk of a glancing CME blow and HSS influence. Activity currently expected to be generally Quiet to Unsettled once again by day 4 (06 Nov).

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is now below the S1 Moderate Radiation Storm level, and continuing to slowly decline. However, any further notable flares bring a persistent chance for further enhancement during the period. The high energy electron flux is expected to be Background to Moderate, with the associated fluence forecast to persist below Active levels.

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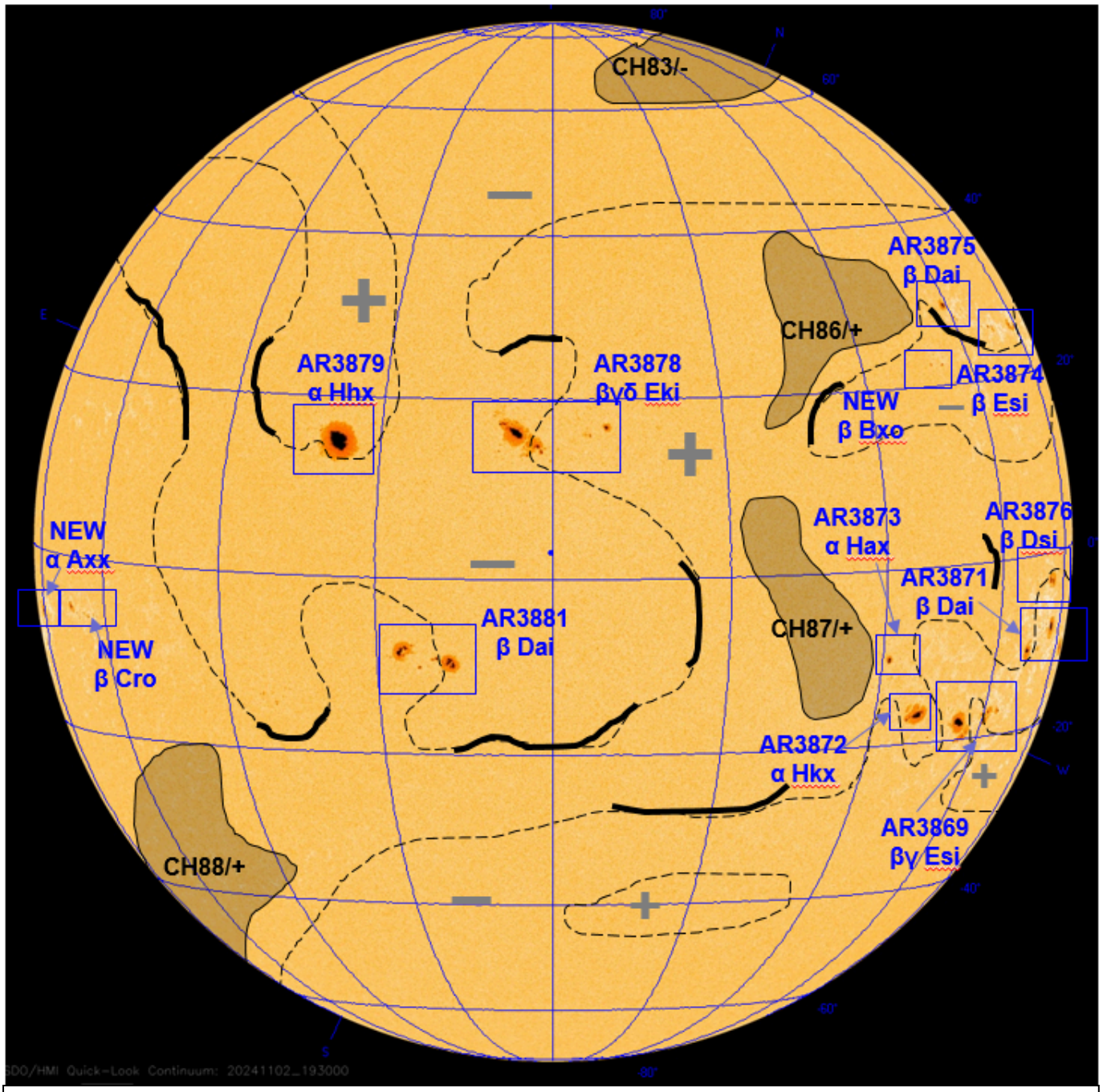
Figure 1: Solar Synoptic Map Vt02/2000UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME which left the Sun during the 31st Oct has the potential to give a glancing blow to Earth late on day 1 (03 Nov) or into early day 2 (04 Nov). This is low confidence however given a lack of imagery for analysis. These recent gaps in available coronagraph imagery, combined with the number of large filaments on the Earth-facing disc and the continued chance for notable flares, results in a CME forecast which has a greater than usual potential to change at short notice in the coming days.

The Earth is experiencing some weak enhancement, likely as a result of another transient CME influence, with winds remaining at slightly elevated levels. Into the period influence from CH86/+, or more likely CH87/+ to its south, may cause further enhancement, perhaps to elevated levels through the latter part of day 1 (02 Nov) or more likely into day 2 (04 Nov) . While these features are recurrent ones, both appear larger and more prominent on this rotation, which suggests that the current solar wind increase might be underestimated by the MOSWOC ENLIL model.

Quiet to Unsettled geomagnetic activity is expected initially due to ongoing weak transient influence, with a chance of Active intervals. Activity expected to increase to become more generally Unsettled later on day 1 (03 Nov) and day 2 (04 Nov), with a chance of Active and a slight chance of G1/Geomagnetic Storm intervals given the risk of a glancing CME blow and HSS influence. Activity currently expected to be generally Quiet to Unsettled once again by day 4 (06 Nov) although forecast lower than usual confidence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	10	5
Strong	G3	No	1	1	1	0
Severe	G4	No	1	1	1	0
Extreme	G5	No	1	1	1	0

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
31/1915	Partial	AR3877	central-southern disk	600	04/0300 +-6hr	Low confidence, glancing blow.

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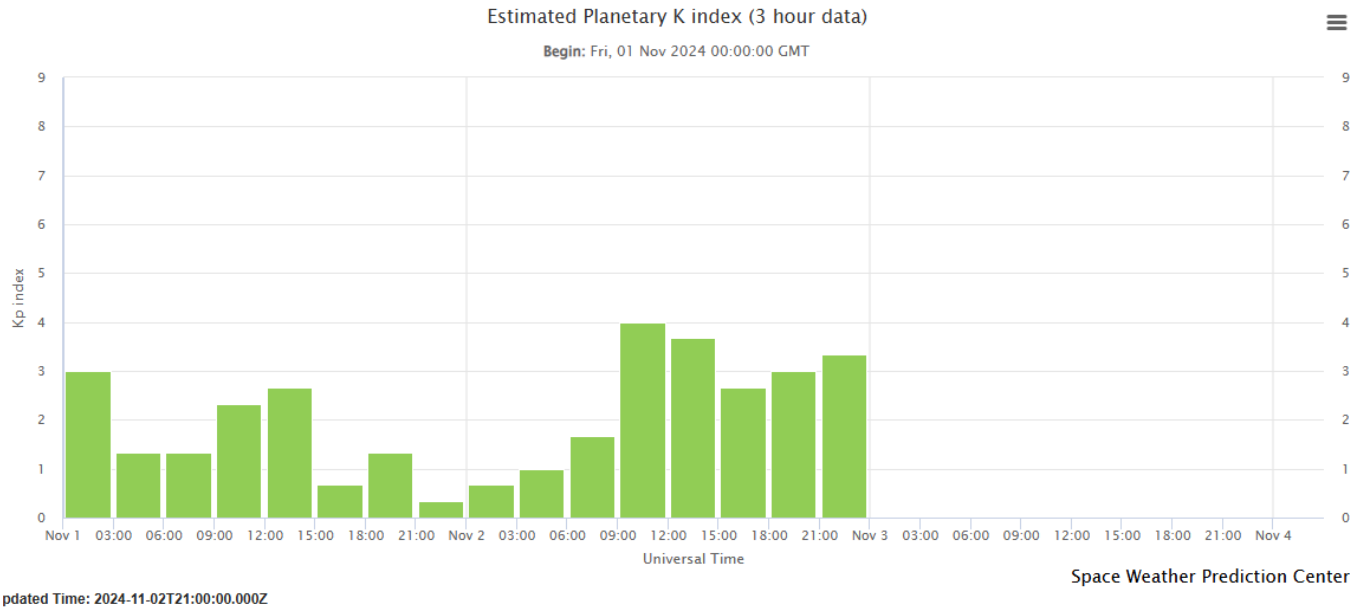
Figure 2: Estimated Planetary K index from NOAA SWPC



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Radio Blackouts - X-Ray Flares

There are thirteen active sunspot regions on the visible disc, with three as yet un-numbered new regions. AR3878 in the NE, and the cluster of spots in the SW, remain the most active flare source regions. AR3878 still has two delta spots visible within its larger trailer portion, although one of these appears to be weakening slightly. AR3869 remains the most complex region within the cluster of spots in the southwest, with opposite polarity to what would be expected for a southern disc sunspot ("anti-Hale"), although the magnetic demarcation between this spot and sounding regions is somewhat unclear. AR3881 in the SE continues to develop with quite large leading and trailing spots. Other sunspots only showing slow evolution currently.

Moderate or High activity is expected to continue initially, with occasional M-class flares expected and a slight chance of isolated X-class flares. By day 2 (04 Nov) and into day 3 (05 Nov) regions leaving the western limb may see a slight decrease in the total flare risk, with recurrence and far-side sounding imagery not suggesting any significant oncoming regions. Therefore the flare risk reducing slightly into the period, although Moderate activity remains likely pending further developments.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	70	70	70
Very Active	R3-R5 (X Class)	No	20	20	15	15

Figure 3: GOES18 X-Ray flux

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Solar Radiation Storms (High Energy Protons)

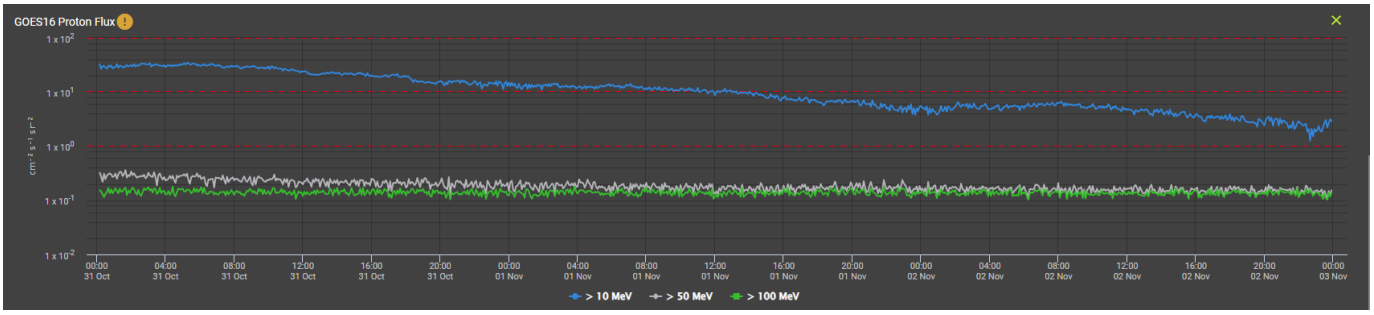
The recently elevated high energy proton flux at GOES-18 over previous days has now fallen below the S1 Minor Radiation storm level and is expected to decline towards background through days 1 and 2 (03-04 Nov) in the absence of any further enhancement.

Further enhancements remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions in the western disc, all of which will remain in potentially geo-effective positions through the period even as some spots round the western limb. The proton risk associated with AR3878 will also only increase into the period as this region transits west, although only limited proton response has been diagnosed from the recent significant flares from this region.

Overall there is a persistent chance of further proton enhancement though the period, reducing slightly through the latter half as conditions likely continue to ease in the absence of further enhancement.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	25	25	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES16 Proton Flux from 31st Oct



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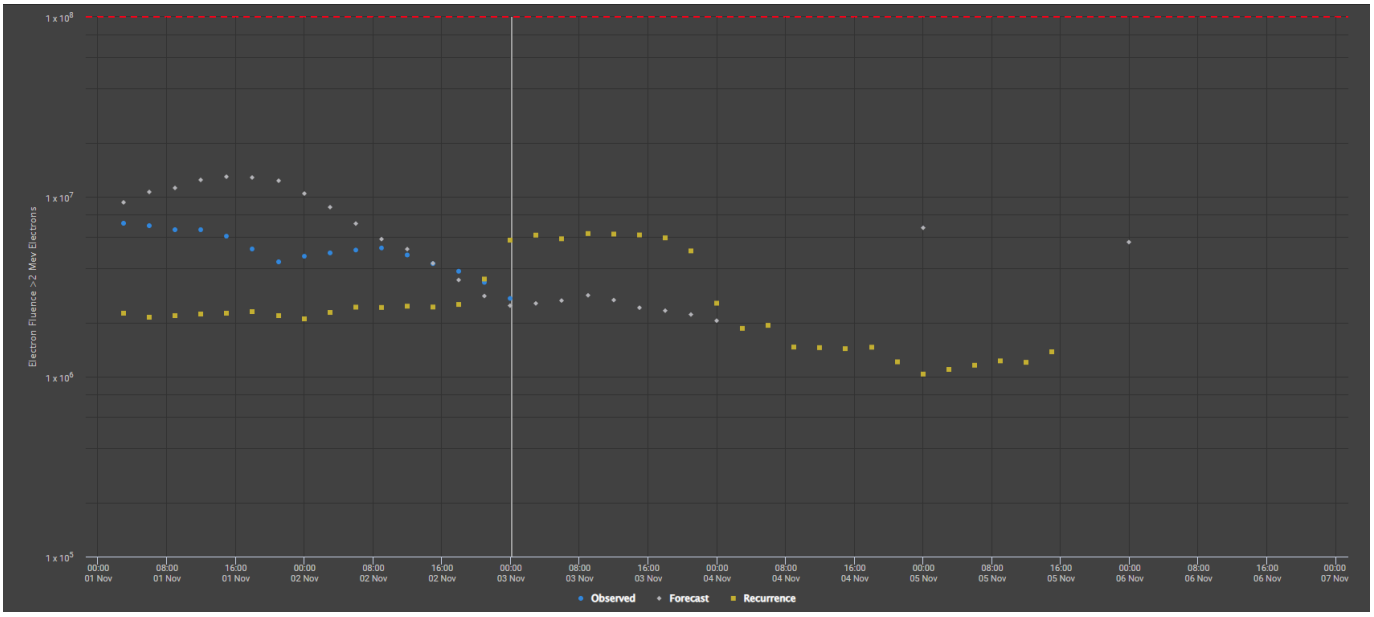
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

Figure 5: MOSWOC REF Model



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